performing measurement for alignment of the substrate, at a position spaced, in the Y direction, from a position where the exposure of the substrate is to be carried out, an X measuring device for performing yaw measurement of said stage by use of an X reflection surface provided on said stage along the Y direction, a Y measuring device for performing yaw measurement of the stage by use of a Y reflection surface provided on the stage along the X direction, and a controller being operable to select yaw measurement information of the X measuring device for an alignment operation including the alignment measurement using the alignment scope, and being operable to select yaw measurement information of the Y measuring device for the scan exposure.--.

IN THE SPECIFICATION:

Please substitute the paragraph beginning at page 1, line 14 and ending at page 2, line 5. A marked-up copy of this paragraph, showing the changes made thereto, is attached.

--Exposure apparatuses for use in the manufacture of semiconductor devices, for example, are currently represented by a step-and-repeat type exposure apparatus (stepper) wherein a substrate (wafer or glass plate) to be exposed is moved stepwise so that a pattern of an original (reticle or mask) is printed on different exposure regions on the substrate in sequence and by sequential exposures with the use of a projection optical system, and a step-and-scan type exposure apparatus (scan type exposure apparatus) wherein, through repetitions of stepwise motion and scanning exposure, lithographic transfer is repeated to different regions on a substrate. Particularly, in scan type exposure apparatuses, since only a portion of a projection optical system close to its optical axis is used with restriction by a slit, higher precision and wider

a2 Cont

picture-angle exposure of a fine pattern can be accomplished. It will, therefore, become the main stream.--.

Please substitute the paragraph beginning at page 2, line 6 and ending at line 26. A marked-up copy of this paragraph, showing the changes made thereto, is attached.

a3

--In conventional scan type exposure apparatuses, usually, a global alignment procedure is made by using an off-axis alignment scope which is disposed in a scan axis direction as viewed from the optical axis of a projection optical system and, after moving a wafer to an exposure start point below the projection optical system (along the scan axis direction), stepwise motion and scanning exposure in regard to a next shot are repeated. In the movement or scanning motion of the wafer, laser interferometers are used to measure the position y of a wafer stage in the scan axis direction (hereinafter, Y direction) and the position x with respect to a direction (hereinafter, X direction) along a horizontal plane and being perpendicular to the scan axis direction as well as rotation θ (yawing) around a vertical axis (hereinafter, Z axis). On the basis of measured data, the wafer stage is servo-controlled. Usually, the yawing measurement for this servo-control is performed only with respect to a single direction, i.e., the scan axis direction.--.

Please substitute the paragraph beginning at page 3, line 2 and ending at line 18. A marked-up copy of this paragraph, showing the changes made thereto, is attached.

a4

--The inventors of the subject application have found that: the yawing measurement data will theoretically be the same, regardless that the measurement is made with

respect to the X direction or Y direction; comparing the results when yawing measurement in a scan type exposure apparatus is made with respect to the X direction and when it is made with respect to the Y direction, synchronization precision during scan is deteriorated when the yawing measurement is made with respect to the X direction while overlay precision based on alignment precision in superposed printing is deteriorated when the yawing measurement is made with respect to the Y direction, both as compared with a case when the stage servo control is made on the basis of the yawing measured value, measured with respect to the other direction, i.e., the Y direction or X direction.--.

Please substitute the paragraph beginning at page 4, line 13 and ending at line 24. A marked-up copy of this paragraph, showing the changes made thereto, is attached.

--In one preferred form of this aspect of the present invention, said first and second measuring means include laser interferometers for projecting laser beams to the same reflection surface and for performing interference measurement based on reflected laser beams. One of the laser interferometers may be used in the first measuring means as an X-direction laser interferometer for measuring the stage position with respect to the X direction, and also used in the second measuring means as a Y-direction laser interferometer for measuring the stage position with respect to the Y direction.--.

Please substitute the paragraph beginning at page 4, line 25 and ending at page 5, line 26. A marked-up copy of this paragraph, showing the changes made thereto, is attached.

--The stage movement may be servo controlled in accordance with the yawing measurement through the first or second measuring means. The first and second measuring means may be selectively used in accordance with the state of operation of the exposure apparatus. For example, for scanning exposure in which scan is made in the Y direction, the stage position measurement may be made by use of a Y-direction laser interferometer, a Y yawing measurement interferometer and an X-direction laser interferometer. Namely, for the scanning exposure, the second measuring means may be used for the yawing measurement. An alignment scope for performing an off-axis alignment measurement to the substrate may be used and, on that occasion, for the movement after the measurement by the alignment scope, the yawing measurement may be performed by use of the measuring means which is related to a direction orthogonal to the movement direction. Namely, when the measurement position of the alignment scope upon the stage is placed in the Y direction as viewed from the optical axis of the projection optical system, for the movement after measurement by the alignment scope, the yawing measurement may be performed by use of the first measuring means, whereas when the measurement position of the alignment scope is placed in the X direction as viewed from the optical axis of the projection optical system, the yawing measurement may be performed by use of the second measuring means.--.

Q6

Please substitute the paragraph beginning at page 5, line 27 and ending at page 6, line 7. A marked-up copy of this paragraph, showing the changes made thereto, is attached.

a7

--For the selective operation of the first and second measuring means, while they may be selectively operated in accordance with the state of operation of the exposure apparatus as described above, one of the measurement data of them may be made effective. Alternatively, the measurement data of the first and second measuring means may be used through averaging processing or statistical processing.--.

Please substitute the paragraph beginning at page 8, line 1 and ending at line 6. A marked-up copy of this paragraph, showing the changes made thereto, is attached.

a8

--(1) When stage servo control is made with respect to the yawing direction on the basis of an interferometer having a measurement axis orthogonal to the scan axis, the flatness of a bar mirror leads to stage external disturbance, causing degradation of synchronization precision during the scan.--.

Please substitute the paragraph beginning at page 8, line 7 and ending at line 20. A marked-up copy of this paragraph, showing the changes made thereto, is attached.

a9

--(2) When automatic global alignment (AGA) is performed by use of an off-axis alignment scope which is positioned in the scan axis direction as viewed from a projection optical system, as in conventional systems, and when stage servo control is made in the yawing direction on the basis of an interferometer in the same direction as the scan axis, a change in orthogonality of bar mirrors between the AGA operation and the scanning exposure operation

Q9 Cont

will cause degradation of overlay precision. This is because of a shift corresponding to the baseline (distance between the alignment scope position and the optical axis of the projection optical system) as multiplied by the change in orthogonality (sin$\Delta\theta$).--.

Please substitute the paragraph beginning at page 9, line 21 and ending at page 10, line 19. A marked-up copy of this paragraph, showing the changes made thereto, is attached.

Q10

--Figure 1 shows a scan type exposure apparatus according to an embodiment of the present invention. Denoted in the drawing at 1 is a reticle, and denoted at 3 is a wafer. Denoted at 2 is a projection optical system for projecting a pattern of the reticle 1 onto the wafer 3. Denoted at 4 is wafer stage for performing X-Y drive and tilt drive of the wafer 3, and denoted at 5 is a stage base on which the wafer stage 4 is mounted. Denoted at 6 is a Y-direction laser interferometer for measuring the position y in the Y direction (Y coordinate) of the wafer 3 by using a laser beam related to the Y direction. Denoted at 7 is a Y yawing measurement interferometer (second yawing measuring means) for detecting any rotation (yawing) θy about the Z axis as the wafer stage 4 moves, in cooperation with the Y-direction laser interferometer 6 and by using the Y-direction laser beam. Denoted at 8 is an X-direction laser interferometer for measuring an X-coordinate x of the wafer 3 by use of a laser beam related to the X direction. Denoted at 9 is an X yawing measurement interferometer (first yawing measuring means) for detecting any rotation (yawing) θx about the Z axis as the wafer stage 4 moves, in cooperation with the X-direction laser interferometer 8 and by using the X-direction laser beam.--.

Please substitute the paragraph beginning at page 11, line 19 and ending at page 12, line 10. A marked-up copy of this paragraph, showing the changes made thereto, is attached.

--In the exposure apparatus illustrated, the alignment scope 12 is disposed in the scan direction (Y direction) of the projection optical system 2 and, as compared with conventional scan type exposure apparatuses wherein the yawing measurement to the stage 4 is performed in the scan axis direction and by using the Y-direction laser interferometer 6 and the Y yawing measurement interferometer 7, there is an X yawing measurement interferometer 9 added, which is operable to perform yawing measurement to the stage 4 in the X direction in cooperation with the X-direction laser interferometer 8. During the scan exposure operation, as conventional, the yawing measurement is performed in the Y direction by using the laser interferometers 6 and 7, whereas for the global alignment (AGA) operation, it is performed in the X direction by using the laser interferometers 8 and 9. The two laser interferometer systems are selectively used in this manner.--.

a11

Please substitute the paragraph beginning at page 12, line 11 and ending at line 20. A marked-up copy of this paragraph, showing the changes made thereto, is attached.

--Thus, during a scan operation, the Y bar mirror 10 functions to perform yawing measurement approximately at a constant position. Thus, there is little influence of the flatness of the bar mirror, and the synchronization precision is not degraded. For the global alignment operation, there is little influence of the orthogonality of the X bar mirror 11 to the Y

a12

a12 cont

bar mirror 10 and, therefore, the overlay precision is improved as compared with that of conventional scan type exposure apparatuses.--.

Please substitute the paragraph beginning at page 13, line 4 and ending at line 23. A marked-up copy of this paragraph, showing the changes made thereto, is attached.

--Figure 2 shows a scan type exposure apparatus according to another embodiment of the present invention. Those components corresponding to those of the Figure 1 embodiment are denoted by like numerals. In the exposure apparatus of Figure 2, as compared with conventional apparatuses described above, the position of the alignment scope 12 with respect to the projection optical system 2 is placed in the X direction (Figure 2), this being contrasted to the Y direction in the conventional structure. With this arrangement, the movement direction in the alignment direction is laid on an X direction which is orthogonal to the scan axis direction (Y direction). Even though the same laser interferometers 6 and 7 are used for yawing measurement in the Y direction, the yawing measurement direction (Y direction) in an alignment operation is preferably laid on a direction orthogonal to the movement direction (X direction). As a result, without degradation of the synchronization precision, the overlay precision can be improved.--.

a13

Please substitute the paragraph beginning at page 13, line 24 and ending at page 14, line 7. A marked-up copy of this paragraph, showing the changes made thereto, is attached.

a14

--In the exposure apparatus of Figure 2, there is an X yawing measurement interferometer 9 added, for performing yawing measurement to the stage 4 in the X direction, in cooperation with the X-direction laser interferometer 8. In accordance with the state of operation other than the alignment operation or scan operation, the yawing data measured with respect to the direction convenient may be selected or the measurement may be switched. Alternatively, both of the yawing measured data may be used through averaging processing or statistical processing.--.

Please substitute the paragraph beginning at page 14, line 11 and ending at line 15. A marked-up copy of this paragraph, showing the changes made thereto, is attached.

a15

--Figure 3 is a flow chart of a procedure for the manufacture of microdevices such as semiconductor chips (e.g., ICs or LSIs), liquid crystal panels, CCDs, thin film magnetic heads or micro-machines, for example.--.

Please substitute the paragraph beginning at page 14, line 16 and ending at page 15, line 6. A marked-up copy of this paragraph, showing the changes made thereto, is attached.

a16

--Step 1 is a design process for designing a circuit of a semiconductor device. Step 2 is a process for making a mask on the basis of the circuit pattern design. Step 3 is a